Pitchlocked

by Lt. Todd Linskey

Propeller malfunctions result in some of the most complex emergency procedures in the P-3 community. When operating normally, the hydraulic prop governor changes blade angle to maintain engine rpm. When the governor fails, the blade angle becomes fixed, and engine rpm becomes a function of the aircraft's true airspeed. If true airspeed becomes too great, you run the risk of a catastrophic failure. If it is allowed to become too low, the engine will flame out. Therefore, no prop malfunction is ever quite the same as the last, making system knowledge and crew resource management (CRM) more critical than ever.

It was one of the first, cool, fall days at NAS Whidbey Island. Temperatures were just above freezing and the skies unusually clear—perfect for the EO and Maverick missile training our crew had scheduled. However, it was also just the type of weather that strains weary propeller seals on aging P-3s. Before starting engines, the flight station copied ATIS with the OAT reported at two degrees Celsius. NATOPS procedures call for starting all motors in low rpm and allowing them to warm up for 10 minutes when outside temperatures are below freezing. This allows engine oil and prop hydraulic fluid to reach operational temperatures, which keeps the seals from leaking. Since we were deploying in December to Misawa, Japan, and OAT was near freezing, we opted to perform cold-weather-start procedures.

After startup and takeoff checks were completed, YB-934 launched to the east out of Whidbey Island for Mountain Home AFB, Idaho. After Condition IV checks, all systems were reported as ops normal. However, that wasn't quite the case.

Passing 7,000 feet, the flight engineer called, "Prop pump No.1 light on No.4 engine." At the same time, a second aircrewman reported to the off-duty flight engineer there was fluid spraying from the No.4 prop. The off-duty FE inspected the prop and verified the leak. In the meantime, the copilot contacted ATC and requested an immediate

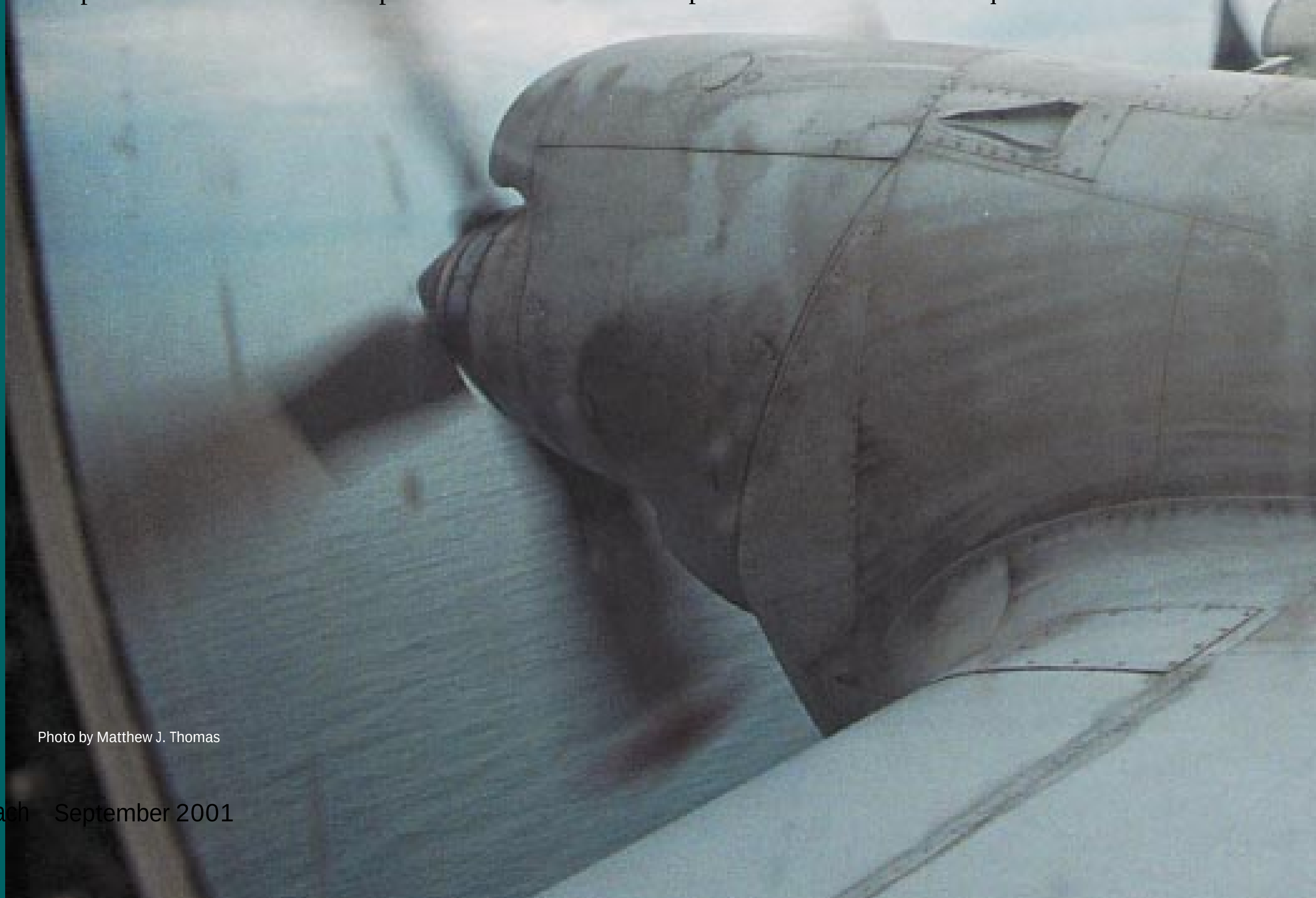

Photo by Matthew J. Thomas

d Propeller

level off at 9,000 feet and clearance direct to the initial approach fix for holding to troubleshoot. The flight station then prepared for the prop to pitchlock.

Shortly after level off at 9,000 feet, the prop pump No. 2 light illuminated, and the prop went to 102 percent rpm. Within seconds, the hydraulic governor failed, and the prop pitchlocked at 104 percent, with the fuel-control-topping governor maintaining rpm.

The prop pitchlocked in a nearly optimal condition. The aircraft continued to accelerate while level at 9,000 feet prior to pitchlock, guaranteeing a high blade-angle (low-blade angles have a greater potential for decouple, which can lead to an uncontrollable oil fire). The aircraft was also at a relatively low altitude in VMC conditions.

After we got the prop under control and entered holding, the thinking game began. Immediately, ATC requested we descend to a lower altitude. We informed them we would be declaring an emergency once we were ready to initiate the approach, but they weren't giving us much slack. After discussing the situation, we requested a block altitude of 5,000 to 7,000 feet, which was approved. We completed the descent checklist, then prepared to secure the motor.

Level at 7,000 feet, the engine was approaching temperature and shaft horsepower limits. We were holding at 220 knots and couldn't slow down because then we would have been stuck at 7,000 feet with the engine at limit power. We briefed the approach, completed the approach checklist, and briefed the upcoming three-engine landing. We then discussed securing the motor and the three possible outcomes of securing an engine using the fuel and ignition switch instead of the emergency-shutdown handle (which would secure the engine and feather the prop). We wouldn't be able to feather the prop, and it would continue to rotate under an air load after the engine had been secured.

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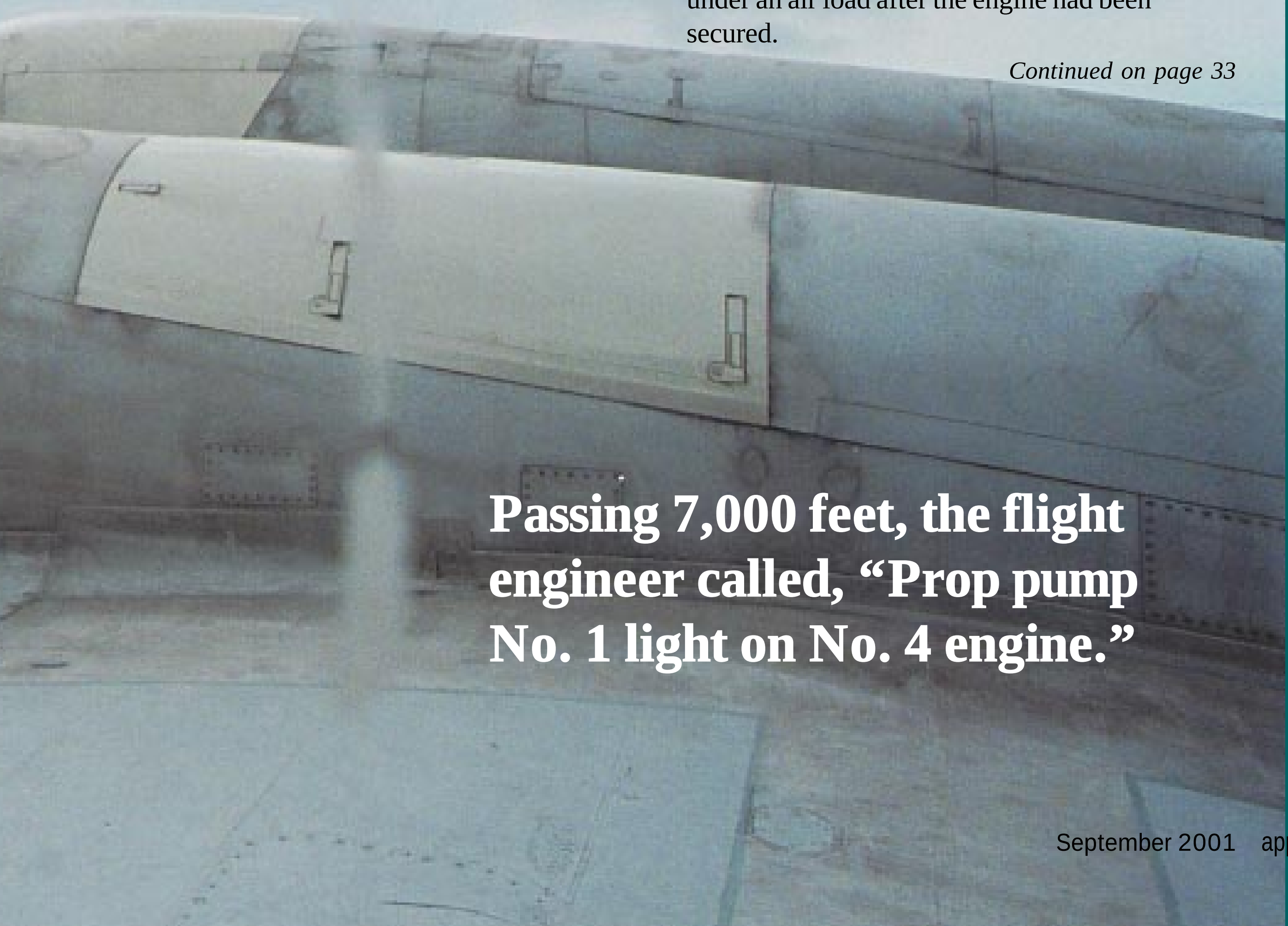

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The first outcome is that you have enough prop hydraulic fluid left to use the e-handle. We didn't expect we would be able to do that based on the rapid rate we had lost hydraulic fluid.

The second outcome is that when the engine shuts down, the prop and engine remained coupled. In this case, the prop remains in a less-than-feathered condition, and the airload on the prop drives the prop and engine. The problems with this situation are a significant decrease in range and the potential for directional-control problems during the approach and landing.

The third outcome occurs when the prop and engine decouple because of excessive air load on the prop. The prop continues to rotate at a high rpm. The air load also will cause the engine to rotate at a very low rpm. The end result is that the engine oil pumps will continue to lubricate the engine, but the scavenge pumps will not be able to maintain a pressure head and oil will pool up inside the engine. The amount of oil going to the reduction gearbox will continue to diminish, eventually causing an extremely hot metal fire in the gearbox.

Level at 7,000 feet, we really had to put the game faces on and work as a team. We were fortunate to have an experienced flight station this day. Both pilots in the seat were qualified aircraft commanders and the third pilot was qualified in model. The first engineer was a qualified instructor. The first task was to make sure we completed all of the NATOPS procedures, which take up the better part of four pages in the big blue book. Then we had to come up with a game plan for securing the engine and shooting the approach. Here we initially split 50-50. I was content to remain in holding and shoot the TACAN following shutdown.

We also discussed descending into the VFR delta pattern over Whidbey Island to minimize the amount of time the motor would be windmilling following shutdown. The problem was to determine if we would be able to get into the delta pattern at a reasonable airspeed. We decided we probably would not be able to descend below 5,000 feet before the engine reached limit power at our current airspeed. We could speed up to get lower, but that would lead to another set of problems.

We remained in holding, and, as predicted, we stopped our descent at 5,000 feet. The motor was at limit shaft horsepower and temperature. We all felt comfortable that we could secure the engine and make a normal descent and approach to the active runway. We completed all checklists and again discussed the potential results of securing the engine with the fuel and ignition switch. My copilot then called ATC with our intention to initiate the TACAN approach to runway 7 and make a three-engine landing.

As we turned inbound from holding, the flight engineer secured the motor. We immediately began to dirty-up to reduce our airspeed and limit the airload on the windmilling prop. As we slowed to 160 knots, the engine indications were negative 600 shaft horsepower and approximately 45 percent rpm. The prop had remained coupled, but there were no indications we would have enough hydraulic fluid to secure the engine with the emergency-shutdown handle.

Established inbound to the IAF, I conducted a slow-flight check at 145 knots, added power on the remaining engines (as I would in the event of a waveoff), and verified aircraft controllability. The plane appeared to handle just like it normally would with one engine out. I then shot the TACAN to runway 7.

The final tricky part of a pitchlocked prop is the landing. When an engine is normally feathered prior to landing, you know how the aircraft will handle on the runway because the drag of the feathered prop is a constant. With the prop pitchlocked, the drag constantly varies as the rpm slowly decays from the time you start the flare until the aircraft comes to a stop. Fortunately the winds and runway conditions this day were favorable, and I was able to slowly reverse on the three operating engines. The windmilling prop didn't create excessive yaw.

From start to landing, this malfunction lasted about an hour. It was probably the most draining hour of flight that any of us ever had labored through, but it was also one of the most rewarding hours. We were faced with a complex emergency and were able to walk away from it with the feeling that we had followed the principles of CRM and NATOPS the way we should.

Lt. Linskey flies with VP-1.